

TEST REPORT

Applicant: TFIVE PTY LTD
Address: 10/29 Lorne Ave Killara NSW 2071 Australia
Equipment Type: LED Bulb T1 (Tunable White)
Model Name: LEDLBT1-L01
Brand Name: Aqara
Test Standard: AS/NZS 4268:2017 (refer section 3)
Test Date: May 27, 2022 - Jun. 07, 2022
Date of Issue: Jun. 30, 2022

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

Tested by: Chen Huiming**Checked by:** Ye Hongji**Approved by:** Liao Jianming

(Technical Director)



Revision History

Version	Issue Date	Revisions
<u>Rev. 01</u>	<u>Jun. 30, 2022</u>	<u>Initial Issue</u>

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1 GENERAL INFORMATION

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe West Road, Nanshan District, ShenZhen, GuangDong Province, China
Phone Number	+86 755 6685 0100

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe West Road, Nanshan District, ShenZhen, GuangDong Province, China
Description	All measurement facilities used to collect the measurement data are located at Block B, 1/F, Baisha Science and Technology Park, Shahe West Road, Nanshan District, ShenZhen, GuangDong Province, China

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	TFIVE PTY LTD
Address	10/29 Lorne Ave Killara NSW 2071 Australia

2.2 Manufacturer Information

Manufacturer	Lumi United Technology Co., Ltd
Address	Room 801-804, Building 1, Chongwen Park, Nanshan iPark, No. 3370, Liuxian Avenue, Fuguang Community, Taoyuan Residential District, Nanshan District, Shenzhen, China

2.3 Factory Information

Factory	N/A
Address	N/A

2.4 General Description for Equipment under Test (EUT)

EUT Name	LED Bulb T1 (Tunable White)
Model Name Under Test	LEDLBT1-L01
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	V2
Software Version	V30
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.5 Technical Information

EUT Type	Stand-alone equipment
Network and Wireless connectivity	Bluetooth (BLE), Zigbee

The requirement for the following technical information of the EUT was tested in this report:

Modulation Mode	O-QPSK
Frequency Range	The frequency range used is 2405 MHz – 2480 MHz; The frequency block is 2400 MHz to 2483.5 MHz.
Number of channel	15
Tested Channel	11 (2405 MHz), 18 (2440 MHz), 25 (2475 MHz)
Antenna Type	Helical Antenna
Antenna Gain	1.0 dBi (In test items related to antenna gain, the final results reflect this figure. This value is provided by the applicant.)
Beamforming Gain	N/A
Adaptive or non-adaptive	Non-Adaptive
LBT Based	Non-LBT
The Max RF Output power	9.7 dBm
Receiver Category	2

2.6 Additional Instructions

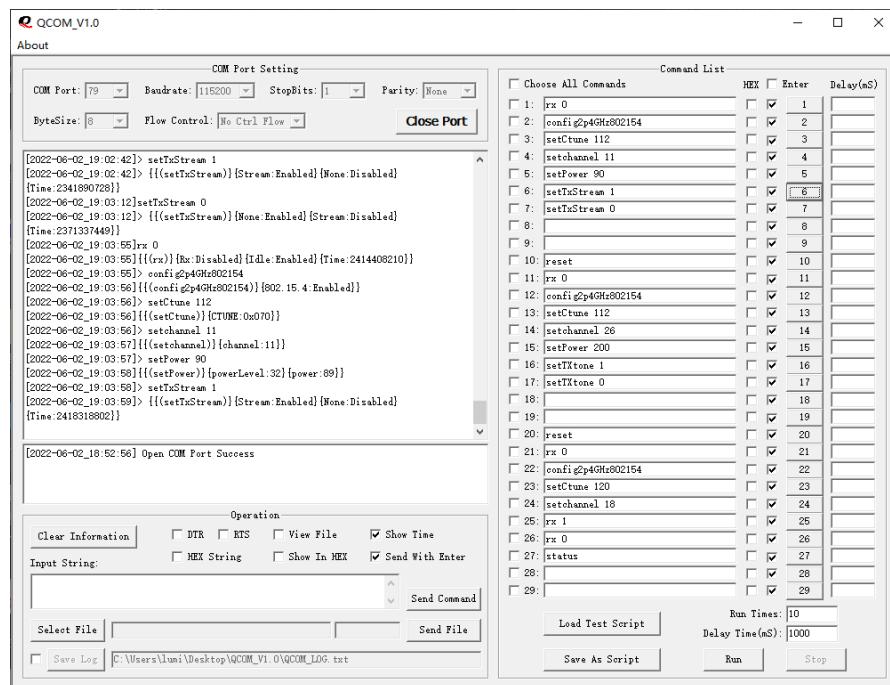
EUT Software Settings:

Mode	<input checked="" type="checkbox"/> Special software is used. The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.
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During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Power level setup in software			
Test Software Version	QCOM_V1.0		
Support Units (Software installation media)	Description	Manufacturer	Model
	Notebook	Dell	N/A
Mode	Channel	Frequency (MHz)	Soft Set
O-QPSK	11	2405	Power parameter Settings is 90
	18	2440	
	25	2475	

Run Software:



3 SUMMARY OF TEST RESULTS

No.	Identity	Document Title
1	AS/NZS 4268:2017	Radio equipment and systems - Short range devices - Limits and methods of measurement
2	ETSI EN 300 328 V2.2.2 (2019-07)	Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz band; Harmonised Standard for access to radio spectrum

Test items and the results are as follows:

Report Section	Standard Rule	Description	Channel	Test Result	Verdict	Remark
Transmitter Parameters						
5.1.1	4.3.1.2 4.3.2.2	RF output power	Low/Middle/High	ANNEX A.1	Pass	--
5.1.2	4.3.2.3	Power Spectral Density	Low/Middle/High	ANNEX A.2	Pass	Note ⁴
5.1.3	4.3.1.3 4.3.2.4	Duty Cycle, Tx-sequence, Tx-gap	N/A	ANNEX A.3	N/A	Note ² , Note ⁷
5.1.4	4.3.1.4	Accumulated Transmit Time, Frequency Occupation and Hopping Sequence	--	ANNEX A.4	N/A	Note ⁵
5.1.5	4.3.1.5	Hopping Frequency Separation	--	ANNEX A.5	N/A	Note ⁵
5.1.6	4.3.1.6 4.3.2.5	Medium Utilization (MU) factor	N/A	ANNEX A.6	N/A	Note ² , Note ⁷
5.1.7	4.3.1.7 4.3.2.6	Adaptivity	N/A	ANNEX A.7	N/A	Note ² , Note ³
5.1.8	4.3.1.8 4.3.2.7	Occupied Channel Bandwidth	Low/High	ANNEX A.8	Pass	--
5.1.9	4.3.1.9 4.3.2.8	Transmitter unwanted emissions in the out-of-band domain	Low/High	ANNEX A.9	Pass	--
5.1.10	4.3.1.10 4.3.2.9	Transmitter unwanted emissions in the spurious domain	Low/High	ANNEX A.10	Pass	--
Receiver Parameters						
5.2.1	4.2.3.2	Receiver categories	--	--	--	--
5.2.2	4.3.1.11 4.3.2.10	Receiver spurious emissions	Low/High	ANNEX A.11	Pass	--
5.2.3	4.3.1.12 4.3.2.11	Receiver Blocking	Low/High	ANNEX A.12	Pass	--
Other Parameters						
5.3.1	4.3.1.13 4.3.2.12	Geo-location capability	--	--	N/A	Note ⁶

Note ¹: This requirement does not apply to adaptive equipment unless operating in a non-adaptive mode.

Note ²: This test doesn't apply for the EUT which has the RF Output power is less than 10 dBm e.i.r.p.

Note ³: This requirement does not apply to non-adaptive equipment or adaptive equipment operating in a non-adaptive mode.

Note ⁴: This requirement apply to the equipment is using wide band modulations other than FHSS.

Note ⁵: This requirement apply to the equipment is using FHSS.

Note ⁶: This requirement does not apply to devices that do not support Geo-location capability.

Note ⁷: These requirements apply to non-adaptive frequency hopping equipment or to adaptive frequency hopping equipment operating in a non-adaptive mode.

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity	59% to 66%		
Atmospheric Pressure	98 kPa to 102 kPa		
Temperature	NT (Normal Temperature)	+20.6°C to +24.8°C	
	LT (Low Temperature)	0°C	
	HT (High Temperature)	+40°C	
Working Voltage of the EUT	NV (Normal Voltage)	230 V	

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-30	103118	2021.08.09	2022.08.08
Spectrum Analyzer	KEYSIGHT	N9020A	MY56060183	2021.09.08	2022.09.07
Vector Signal Generator	ROHDE&SCHWARZ	SMBV100A	260592	2022.02.09	2023.02.08
Signal Generator	ROHDE&SCHWARZ	SMB100A	177746	2021.08.24	2022.08.23
Switch Unit with OSP-B157	ROHDE&SCHWARZ	OSP120	101270	2022.05.19	2023.05.18
Signaling Unit	ROHDE&SCHWARZ	CMW270	100607	2022.05.19	2023.05.18
Signaling Unit	ROHDE&SCHWARZ	CMW500	142028	2022.05.19	2023.05.18
Signaling Unit	ROHDE&SCHWARZ	CBT	101005	2022.05.19	2023.05.18
DC Power Supply	ITECH	IT6720	60010301071 7610007	2021.09.22	2022.09.21
Temperature Chamber	AHK	NTH64-40A	1310	2022.01.05	2023.01.04
EMI Receiver	KEYSIGHT	N9038A	MY53220118	2021.09.13	2022.09.12
Test Antenna-Loop(9 kHz-30 MHz)	SCHWARZBECK	FMZB 1519	1519-037	2021.04.16	2024.04.15
Test Antenna-Bi-Log(30 MHz-3 GHz)	SCHWARZBECK	VULB 9163	9163-624	2021.08.20	2024.08.19
Test Antenna-Horn(1-18 GHz)	SCHWARZBECK	BBHA 9120D	9120D-1917	2019.07.02	2022.07.01
Test Antenna-Horn (18-40 GHz)	A-INFO	LB-180400KF	J211060273	2021.07.02	2024.07.01
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2022.02.19	2024.09.03

4.3 Test Software List

Description	Manufacturer	Software Version	Serial No.
TS8997 EMC32	ROHDE&SCHWARZ	V10.01.00	N/A

4.4 Measurement Uncertainty

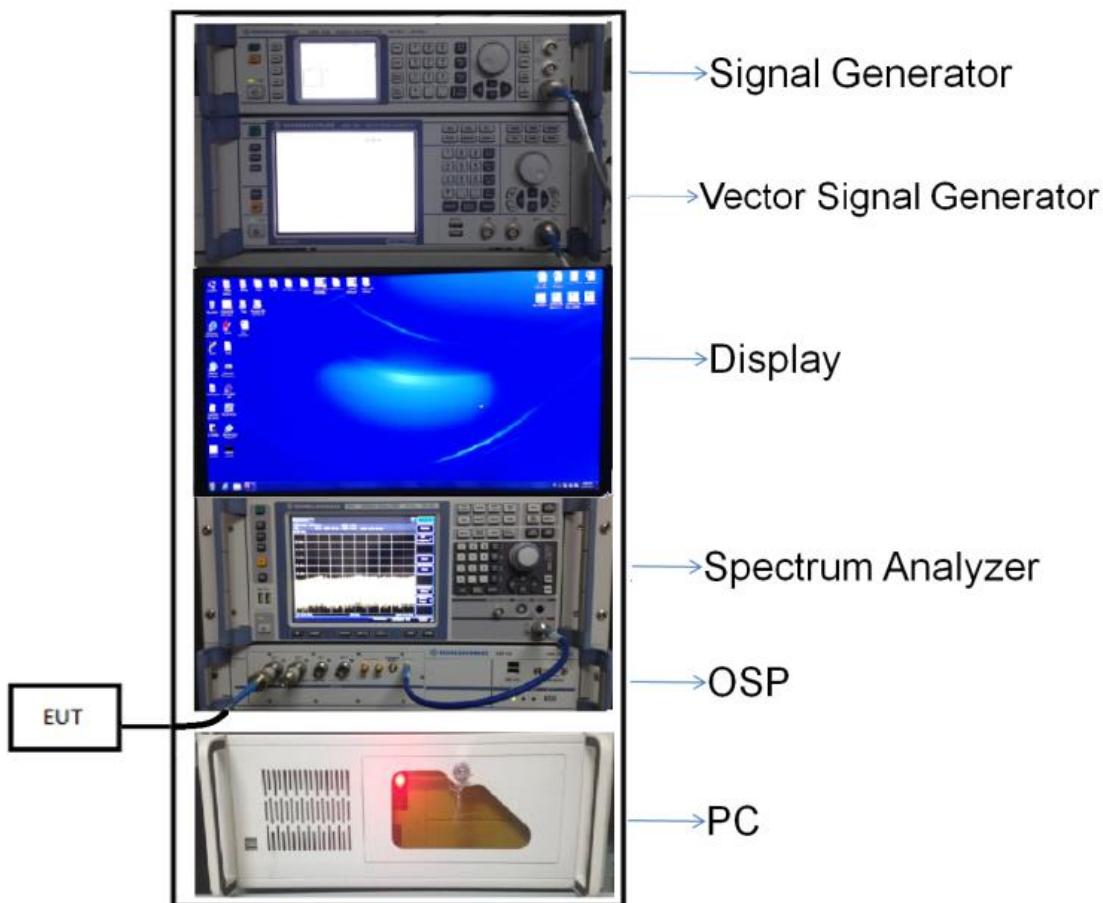
The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Parameters	Uncertainty
Occupied Channel Bandwidth	3.6 %
RF output power, conducted	0.66 dB
Power Spectral Density, conducted	0.90 dB
Unwanted Emissions, conducted	1.78 dB
All emissions, radiated	5.36 dB
Temperature	0.82 °C
Humidity	4.1 %

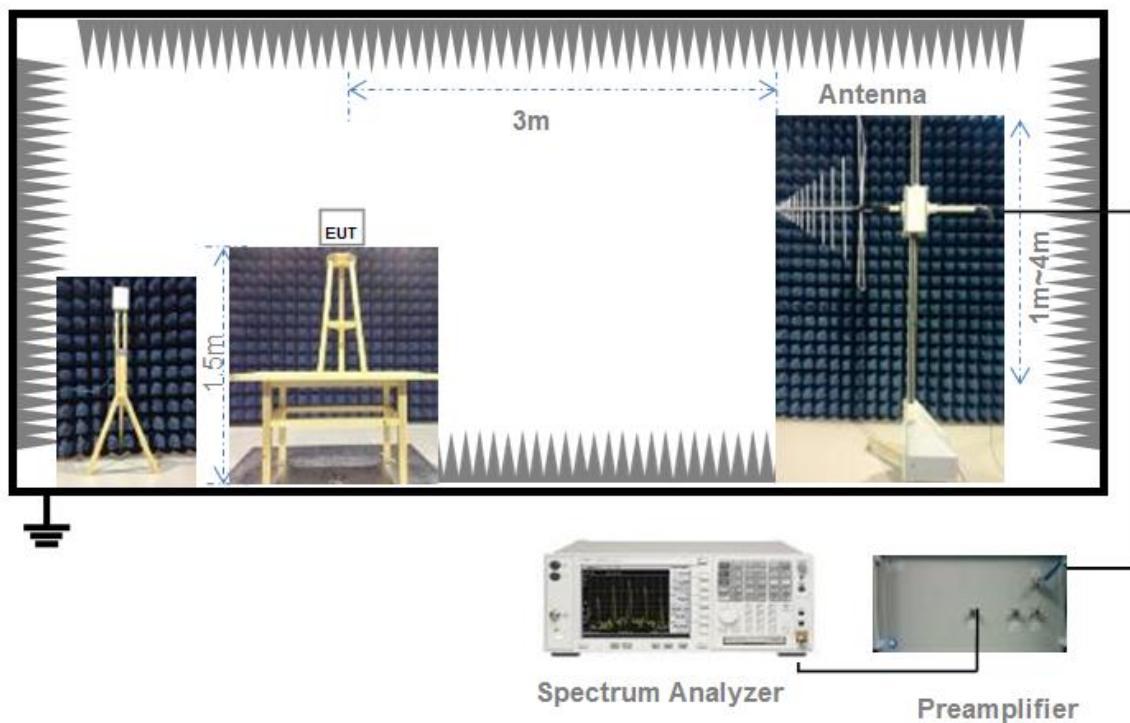
4.5 Description of Test Setup

4.5.1 For Conducted Test

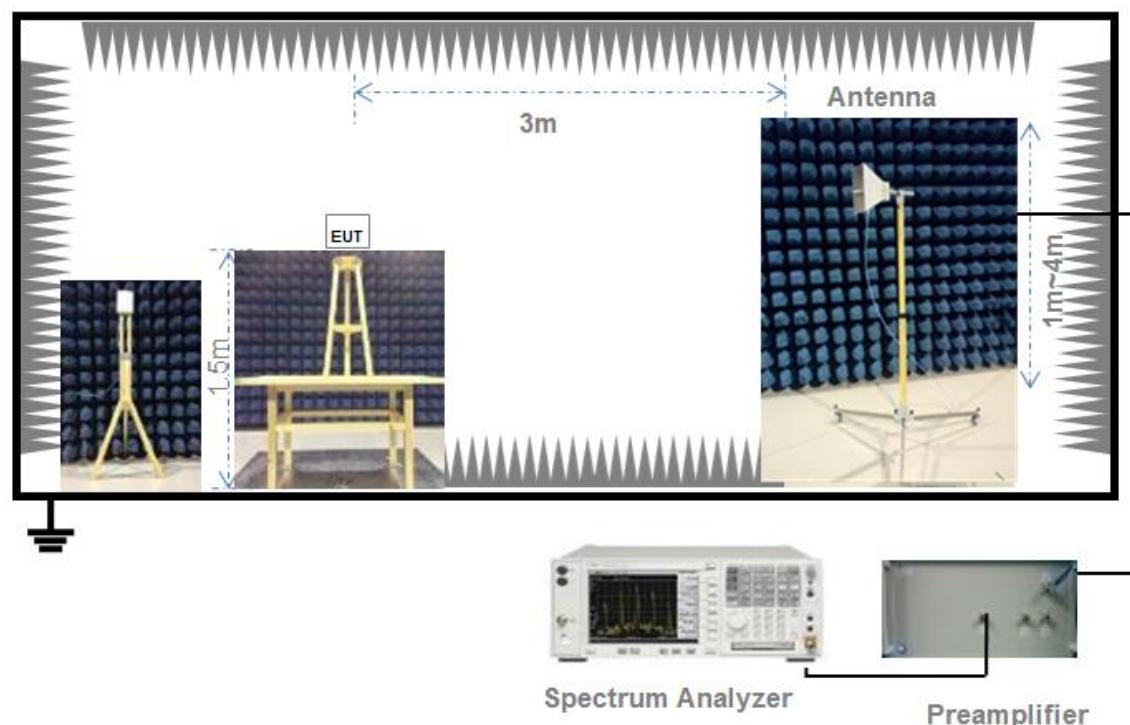


(Diagram 1)

4.5.2 For Radiated Test

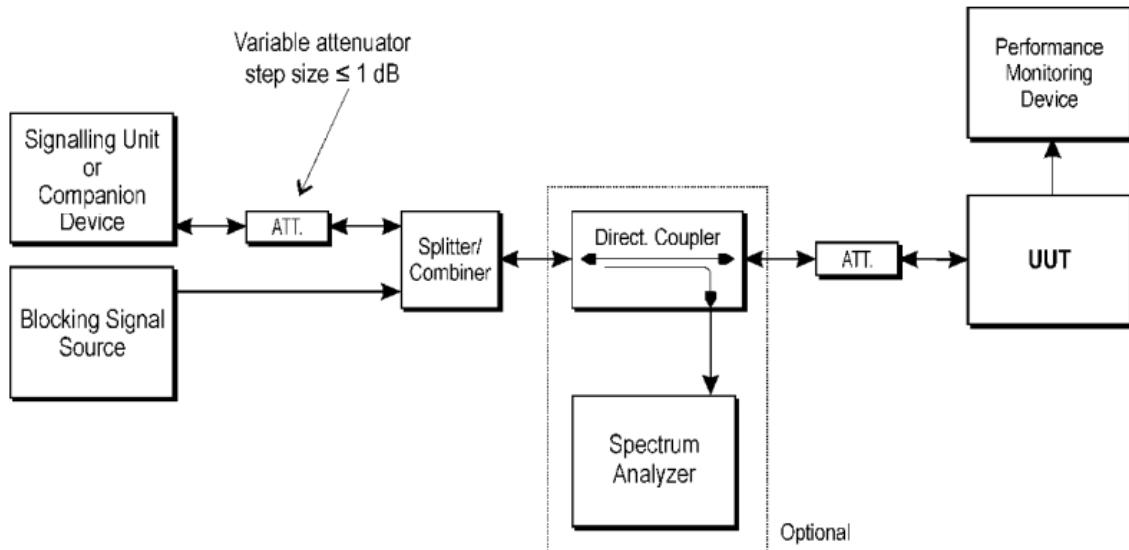


(Diagram 2)



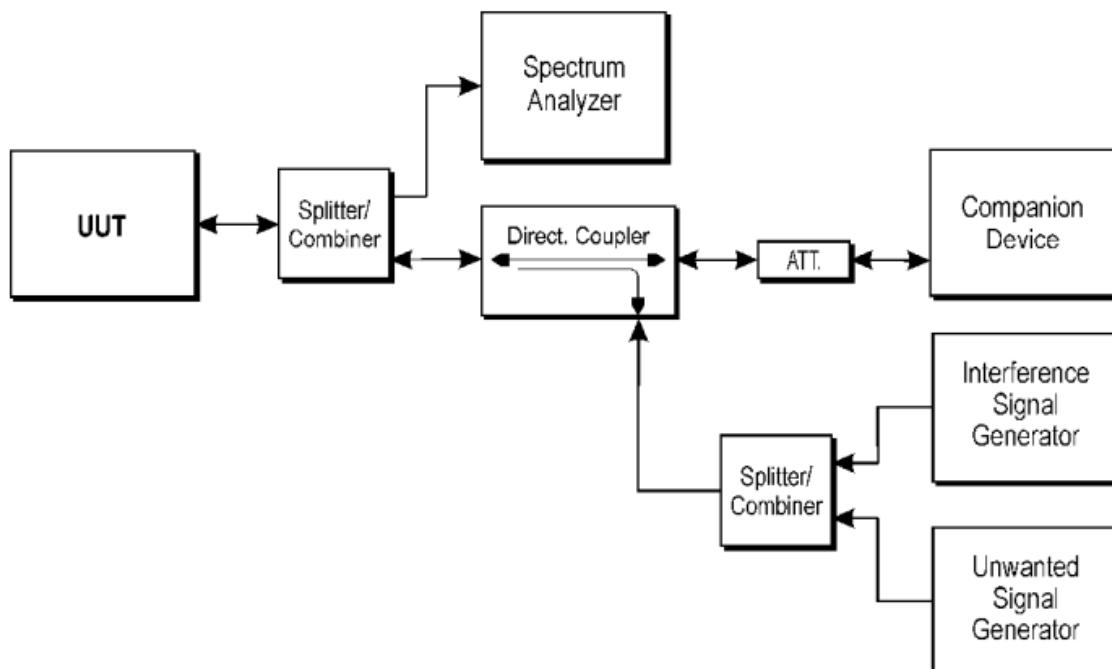
(Diagram 3)

4.5.3 For Receiver Blocking Test



(Diagram 4)

4.5.4 For Adaptivity Test



(Diagram 5)

5 Test Type and Test Results

5.1 Transmitter Parameters

5.1.1 RF output power

5.1.1.1 Limit

The maximum RF output power shall be equal to or less than 20 dBm.

5.1.1.2 Test Setup

The section 4.5.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.1.1.3 Test Procedure

Reference to ETSI EN 300 328 V2.2.2 clause 5.4.2.2.

5.1.1.4 Test Result

Please refer to ANNEX A.1.

5.1.2 Power Spectral Density

5.1.2.1 Limit

The maximum Power Spectral Density for non-FHSS equipment is 10 dBm per MHz.

5.1.2.2 Test Setup

The section 4.5.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.1.2.3 Test Procedure

Reference to ETSI EN 300 328 V2.2.2 clause 5.4.3.2.

5.1.2.4 Test Result

Please refer to ANNEX A.2.

5.1.3 Duty Cycle, Tx-sequence, Tx-gap

5.1.3.1 Limit

The Duty Cycle shall be equal to or less than the maximum value declared by the manufacturer.

The Tx-sequence time shall be equal to or less than 10 ms.

The minimum Tx-gap time following a Tx-sequence shall be equal to the duration of that proceeding Txsequence
with a minimum of 3,5 ms.

5.1.3.2 Test Setup

The section 4.5.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.1.3.3 Test Procedure

Reference to ETSI EN 300 328 V2.2.2 clause 5.4.2.2.

5.1.3.4 Test Result

Please refer to ANNEX A.3.

5.1.4 Accumulated Transmit Time, Frequency Occupation and Hopping Sequence

5.1.4.1 Limit

The Accumulated Transmit Time on any hopping frequency shall not be greater than 400 ms within any observation period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

The hopping sequence(s) shall contain at least N hopping frequencies where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options:

Option 1: Each hopping frequency of the hopping sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use.

Option 2: The occupation probability for each frequency shall be between $((1 / U) \times 25\%)$ and 77 % where U is the number of hopping frequencies in use.

5.1.4.2 Test Setup

The section 4.5.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.1.4.3 Test Procedure

Reference to ETSI EN 300 328 V2.2.2 clause 5.4.4.2.

5.1.4.4 Test Result

Please refer to ANNEX A.4.

5.1.5 Hopping Frequency Separation

5.1.5.1 Limit

For adaptive frequency hopping systems, the minimum Hopping Frequency Separation shall be 100 kHz.

5.1.5.2 Test Setup

The section 4.5.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.1.5.3 Test Procedure

Reference to ETSI EN 300 328 V2.2.2 clause 5.4.5.2.

5.1.5.4 Test Result

Please refer to ANNEX A.5.

5.1.6 Medium Utilization (MU) factor

5.1.6.1 Limit

The maximum Medium Utilization factor for non-adaptive equipment shall be 10 %.

5.1.6.2 Test Setup

The section 4.5.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.1.6.3 Test Procedure

Reference to ETSI EN 300 328 V2.2.2 clause 5.4.2.2.

5.1.6.4 Test Result

Please refer to ANNEX A.6.

5.1.7 Adaptivity

5.1.7.1 Limit

Adaptive Frequency Hopping

Requirement	Operational Mode	
	Non-LBT based Detect and Avoid	LBT based Detect and Avoid
Minimum Clear Channel Assessment (CCA) Time	NA	18 us (see Note ¹)
Maximum Channel Occupancy (COT) Time	40 ms	60 ms
Minimum Idle Period	5% of COT	5% of COT
Extended CCA check	NA	NA
Short Control Signalling Transmissions	Maximum duty cycle of 10 % within an observation period of 50 ms (see Note ²)	

Note ¹: The CCA time used by the equipment shall be declared by the supplier.

Note ²: Adaptive equipment may or may not have Short Control Signalling Transmissions.

Note ³: The Idle Period is considered to be equal to the CCA or Extended CCA time defined in clause 4.3.2.6.3.2.3, step 1 and step 2.

Note ⁴: The Idle Period in between transmissions is considered to be the CCA or the Extended CCA check as there are no transmissions during this period.

Interference threshold level:

Maximum transmit power (P_H) EIRP dBm	Threshold level (TL) (see notes 1 and 2)
20	-70 dBm / MHz
Note ¹ : $TL = -70 \text{ dBm/MHz} + 10 \times \log_{10} (100 \text{ mW} / P_{out})$ (Pout in mW e.i.r.p.).	
Note ² : transmitter the CCA threshold level (TL) shall be equal or lower than -70 dBm/MHz at the input to the receiver (assuming a 0 dBi receive antenna).	

Unwanted Signal parameters

Wanted signal mean power from companion device	Unwanted signal frequency (MHz)	Unwanted CW signal power (dBm)
sufficient to maintain the link (see Note ²)	2 395 or 2 488,5 (see Note ¹)	-35 (see Note ³)
Note ¹ : The highest frequency shall be used for testing operating channels within the range 2400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483.5 MHz. See clause 5.4.6.1.		
Note ² : A typical value which can be used in most cases is -50 dBm/MHz.		
Note ³ : The level specified is the level in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.		

Adaptive equipment using modulations other than FHSS

Requirement	Operational Mode			
	Non-LBT based Detect and Avoid	LBT based Detect and Avoid		
		Frame Based Equipment	Load Based Equipment (CCA using 'energy detect')	Load Based Equipment (CCA not using any of the mechanisms referenced as Note ²)
Minimum Clear Channel Assessment (CCA) Time	NA	18 us (see Note ¹)	(see Note ²)	18 us (see Note ¹)
Maximum Channel Occupancy (COT) Time	40 ms	1 ms to 10 ms	(see Note ²)	13 ms
Minimum Idle Period	5% of COT	5% of COT	(see Note ²)	NA
Extended CCA check	NA	NA	(see Note ²)	a random duration in the range between 18 μ s and at least 160 μ s
Short Control Signalling Transmissions	Maximum duty cycle of 10 % within an observation period of 50 ms (see Note ³)			
<p>Note ¹: The CCA time used by the equipment shall be declared by the supplier.</p> <p>Note ²: Load Based Equipment may implement an LBT based spectrum sharing mechanism based on the Clear Channel Assessment (CCA) mode using energy detect, as described in IEEE 802.11™-2012 [i.3] clause 9, clause 10, clause 16, clause 17, clause 19 and clause 20, or in IEEE 802.15.4™-2011 [i.4], clause 4, clause 5 and clause 8</p> <p>Note ³: Adaptive equipment may or may not have Short Control Signalling Transmissions.</p> <p>Note ⁴: The Idle Period is considered to be equal to the CCA or Extended CCA time defined in clause 4.3.2.6.3.2.3, step 1 and step 2.</p> <p>Note ⁵: The Idle Period in between transmissions is considered to be the CCA or the Extended CCA check as there are no transmissions during this period.</p>				

Interference threshold level:

Maximum transmit power (P_H) EIRP dBm	Threshold level (TL) (see notes 1 and 2)
20	-70 dBm / MHz
Note 1: $TL = -70 \text{ dBm/MHz} + 10 \times \log_{10} (100 \text{ mW} / P_{out})$ (P_{out} in mW e.i.r.p.).	
Note 2: transmitter the CCA threshold level (TL) shall be equal or lower than -70 dBm/MHz at the input to the receiver (assuming a 0 dBi receive antenna).	

Unwanted Signal parameters

Wanted signal mean power from companion device	Unwanted signal frequency (MHz)	Unwanted CW signal power (dBm)
sufficient to maintain the link (see note 2)	2 395 or 2 488,5 (see note 1)	-35 (see note 3)

Note ¹: The highest frequency shall be used for testing operating channels within the range 2400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483.5 MHz. See clause 5.4.6.1.

Note ²: A typical value which can be used in most cases is -50 dBm/MHz.

Note ³: The level specified is the level in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.

5.1.7.2 Test Setup

The section 4.5.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.1.7.3 Test Procedure

Reference to ETSI EN 300 328 V2.2.2 clause 5.4.6.2.

5.1.7.4 Test Result

Please refer to ANNEX A.7.

5.1.8 Occupied Channel Bandwidth

5.1.8.1 Limit

The Occupied Channel Bandwidth for each hopping frequency shall fall completely within the band 2400 MHz to 2483.5 MHz.

In addition, for non-adaptive FHSS equipment with e.i.r.p. greater than 10 dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than 5 MHz..

In addition, for non-adaptive non-FHSS equipment with e.i.r.p. greater than 10 dBm, the Occupied Channel Bandwidth shall be equal to or less than 20 MHz.

5.1.8.2 Test Setup

The section 4.5.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.1.8.3 Test Procedure

Reference to ETSI EN 300 328 V2.2.2 clause 5.4.7.2.

5.1.8.4 Test Result

Please refer to ANNEX A.8.

5.1.9 Transmitter unwanted emissions in the out-of-band domain

5.1.9.1 Limit

The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in figure 1.

NOTE: Within the 2400 M Hz to 2483,5 MHz band, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.1.8.

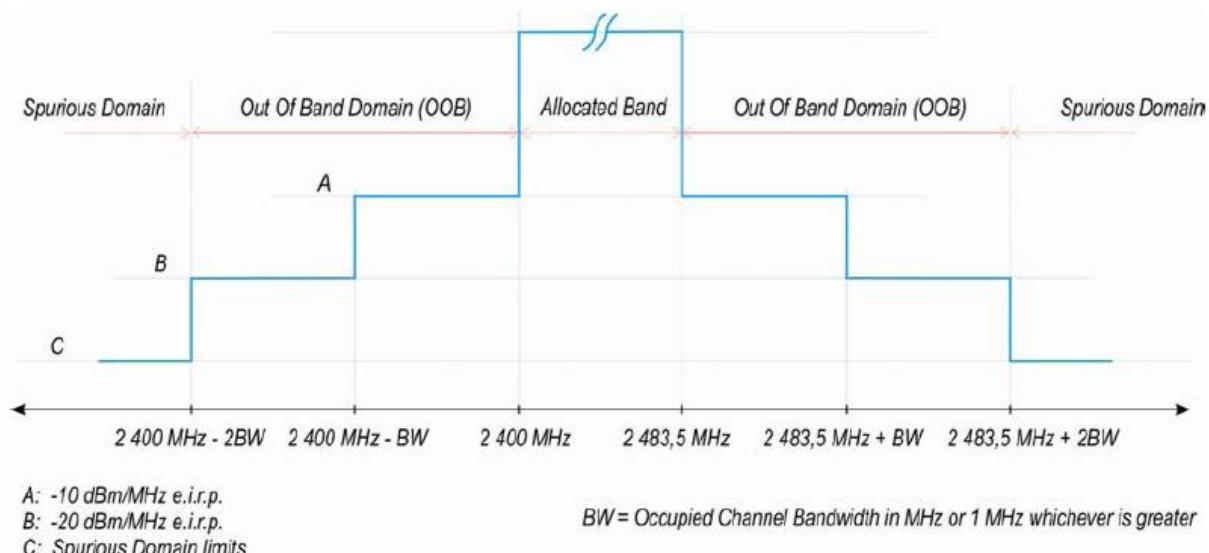


Figure 1: Transmit mask

5.1.9.2 Test Setup

The section 4.5.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.1.9.3 Test Procedure

Reference to ETSI EN 300 328 V2.2.2 clause 5.4.8.2.

5.1.9.4 Test Result

Please refer to ANNEX A.9.

5.1.10 Transmitter unwanted emissions in the spurious domain

5.1.10.1 Limit

The transmitter unwanted emissions in the spurious domain shall not exceed the values in following tables:

Frequency range	Maximum power (dBm)	Bandwidth
30 MHz to 47 MHz	-36	100 kHz
47 MHz to 74 MHz	-54	100 kHz
74 MHz to 87.5 MHz	-36	100 kHz
87.5 MHz to 118 MHz	-54	100 kHz
118 MHz to 174 MHz	-36	100 kHz
174 MHz to 230 MHz	-54	100 kHz
230 MHz to 470 MHz	-36	100 kHz
470 MHz to 694 MHz	-54	100 kHz
694 MHz to 1 GHz	-36	100 kHz
1 GHz to 12.75 GHz	-30	1 MHz

5.1.10.2 Test Setup

The section 4.5.1 and 4.5.2 (Diagram 1, 2, 3) for test setup description. The photo of test setup please refer to ANNEX B.

5.1.10.3 Test Procedure

Reference to ETSI EN 300 328 V2.2.2 clause 5.4.9.2.

5.1.10.4 Test Result

Please refer to ANNEX A.10.

5.2 Receiver Parameters

5.2.1 Receiver categories

There are three different receiver categories for which different receiver requirements and/or corresponding limits apply.

Receiver Category	
Receiver Category	Definition
Category 1	Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p.
Category 2	Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment and non-adaptive with a maximum RF output power of 10 dBm e.i.r.p.
Category 3	Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % or adaptive equipment and non-adaptive with a maximum RF output power of 0 dBm e.i.r.p.

5.2.2 Receiver Spurious Emissions

5.2.2.1 Limit

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode.

The spurious emissions of the transmitter shall not exceed the values in following tables for the EUT in this report.

Frequency range	Maximum power (dBm)	Bandwidth
30 MHz to 1 GHz	-57	100 KHz
1 GHz to 12.75 GHz	-47	1 MHz

5.2.2.2 Test Setup

The section 4.5.1 (Diagram 1) for test setup description. The photo of test setup please refer to ANNEX B.

5.2.2.3 Test Procedure

Reference to ETSI EN 300 328 V2.2.2 clause 5.4.10.2.

5.2.2.4 Test Result

Please refer to ANNEX A.11.

5.2.3 Receiver Blocking

5.2.3.1 Limit

While maintaining the minimum performance criteria as defined in clause 4.3.1.12.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in next table.

Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 4)	Blocking signal frequency(MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal
(-133 dBm + 10 × log ₁₀ (OCBW)) or -68 dBm whichever is less (see note 2)	2 380	-34	CW
	2 504	-34	CW
(-139 dBm + 10 × log ₁₀ (OCBW)) or -74 dBm whichever is less (see note 3)	2 300	-34	CW
	2 330	-34	CW
	2 360	-34	CW
	2 524	-34	CW
	2 584	-34	CW
	2 674	-34	CW

Note ¹: OCBW is in Hz.

Note ²: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.

Note ³: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 20 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.

Note ⁴: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.

Receiver Category 2 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × log ₁₀ (OCBW) + 10 dB) or (-74 dBm + 10 dB) whichever is less (see note 2)	2 380	-34	CW
	2 504	-34	CW
	2 300	-34	CW
	2 584	-34	CW

NOTE ¹: OCBW is in Hz.

NOTE ²: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to Pmin + 26 dB where Pmin is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.

NOTE ³: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.

Receiver Category 3 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency(MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × log ₁₀ (OCBW) + 20 dB) or (-74 dBm + 20 dB) whichever is less (see note 2)	2 380	-34	CW
	2 504	-34	CW
	2 300	-34	CW
	2 584	-34	CW

NOTE ¹: OCBW is in Hz.

NOTE ²: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to Pmin + 30 dB where Pmin is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.

NOTE ³: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.

Categorization

Receiver category	Definition
1	Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p. shall be considered as receiver category 1 equipment.
2	Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment with a maximum RF output power of 10 dBm e.i.r.p. shall be considered as receiver category 2 equipment.
3	Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % or adaptive equipment with a maximum RF output power of 0 dBm e.i.r.p. shall be considered as receiver category 3 equipment

5.2.3.2 Test Setup

See the section 4.5.3 (Diagram 4) for test setup description. The photo of test setup please refer to ANNEX B.

5.2.3.3 Test Procedure

Reference to ETSI EN 300 328 V2.2.2 clause 5.4.11.2.

5.2.3.4 Test Result

Please refer to ANNEX A.12.

5.3 Other Parameters

5.3.1 Geo-location capability

5.3.1.1 Requirements

The geographical location determined by the equipment as defined in following section (5.3.1.2) shall not be accessible to the user.

5.3.1.2 Definition

Geo-location capability is a feature of the equipment to determine its geographical location with the purpose to

configure itself according to the regulatory requirements applicable at the geographical location where it operates.

The geo-location capability may be present in the equipment or in an external device (temporary) associated with the equipment operating at the same geographical location during the initial power up of the equipment. The geographical location may also be available in equipment already installed and operating at the same geographical location.

5.3.1.3 Test Result

Note: Not applicable.

ANNEX A TEST RESULT

A.1 RF output power

Test Data

Note: EIRP Power = Conducted Power + Antenna Gain

Modulation Mode		O-QPSK		
Limit		20 dBm		
Test Result				
Test Method	Test Conditions		Transmitter Power Level (dBm)	
<input type="checkbox"/> Radiated <input checked="" type="checkbox"/> Conducted	Voltage	Temperature	Low Channel	Middle Channel
			EIRP	EIRP
		NT	9.6	9.6
		NV	9.5	9.6
		HT	9.3	9.4
Test Verdict		Pass		

Bursts Power List

O-QPSK: Low Channel

Burst RMS Power	Start Time	Stop Time	Tx_on	Tx_off
dBm	ms	ms	ms	ms
9.6	0.000	1000.000	1000.000	0.000

O-QPSK: Middle Channel

Burst RMS Power	Start Time	Stop Time	Tx_on	Tx_off
dBm	ms	ms	ms	ms
9.6	0.000	1000.000	1000.000	0.000

O-QPSK: High Channel

Burst RMS Power	Start Time	Stop Time	Tx_on	Tx_off
dBm	ms	ms	ms	ms
9.7	0.000	1000.000	1000.000	0.000

A.2 Power spectral density

Measuring Parameter

Frequency Range	
2400 MHz to 2483.5 MHz	RBW (MHz)
	VBW (MHz)
	Sweep points
	Detector mode
	Trace mode
	Sweep time

Test Data

Note: The Power density is ERIP Power density, which is contain antenna gain.

Modulation Mode		O-QPSK		
Limit		10 dBm/MHz		
Test Result				
Test Method	Test Conditions		Power density (dBm/MHz)	
	Temperature	Voltage	Low Channel	Middle Channel
			Power Spectral density	Power Spectral density
<input type="checkbox"/> Radiated <input checked="" type="checkbox"/> Conducted	NT	NV	7.56	7.56
Test Verdict		Pass		

A.3 Duty Cycle, Tx-sequence, Tx-gap

Note ¹: The maximum value of Duty Cycle declared by the supplier.

Test Data

Duty Cycle (%)	Limit Duty Cycle (%) ^{Note1}	Number of Bursts	Minimum Tx-On (ms)	Maximum Tx-On (ms)	Minimum Tx-Off (ms)	Maximum Tx-Off (ms)	Measurement Time (ms)	Comment
--	--	--	--	--	--	--	--	--

Note ²: Not applicable.

A.4 Accumulated Transmit Time, Frequency Occupation and Hopping

Sequence

Note: Not applicable.

A.5 Hopping Frequency Separation

Note: Not applicable.

A.6 Medium Utilization (MU) factor

Medium Utilization (MU) (%)	Limit Medium Utilization (MU) (%)	Verdict
--	10	--

Note: Not applicable.

A.7 Adaptivity

Note: Not applicable.

A.8 Occupied Channel Bandwidth

Measuring Parameter

Centre Frequency	The centre frequency of the channel under test
RBW	~ 1 % of the span without going below 1 %
VBW	3 × RBW
Span	2 × Nominal Channel Bandwidth
Detector mode	RMS
Trace mode	Max Hold
Sweep time	Auto
Test Method	<input type="checkbox"/> Radiated <input checked="" type="checkbox"/> Conducted

Test Data

Test Conditions		Test Mode	DUT Frequency (MHz)	Occupied Channel Bandwidth (MHz)	Lower Band Edge (MHz)	Upper Band Edge (MHz)	Limit (MHz)
Temperatu re	Voltage						
NT	NV	O-QPSK	2405	2.233	2403.886719	2406.119719	Within The Band 2400 MHz to 2483.5 MHz
			2475	2.240	2473.879883	2476.119883	
Test Verdict		Pass					

Test Plots

O-QPSK: Low Channel



O-QPSK: High Channel



A.9 Transmitter unwanted emissions in the out-of-band domain

O-QPSK

DUT Frequency (MHz)	Nominal Bandwidth (MHz)	Frequency (MHz)	Level (dBm)	Limit (dBm)	Result
2405	2	2396.5	-37.700	-20	PASS
2405	2	2397.5	-37.054	-20	PASS
2405	2	2398.5	-35.556	-10	PASS
2405	2	2399.5	-32.870	-10	PASS
2475	2	2484.0	-37.220	-10	PASS
2475	2	2485.0	-37.992	-10	PASS
2475	2	2486.0	-38.110	-20	PASS
2475	2	2487.0	-38.518	-20	PASS

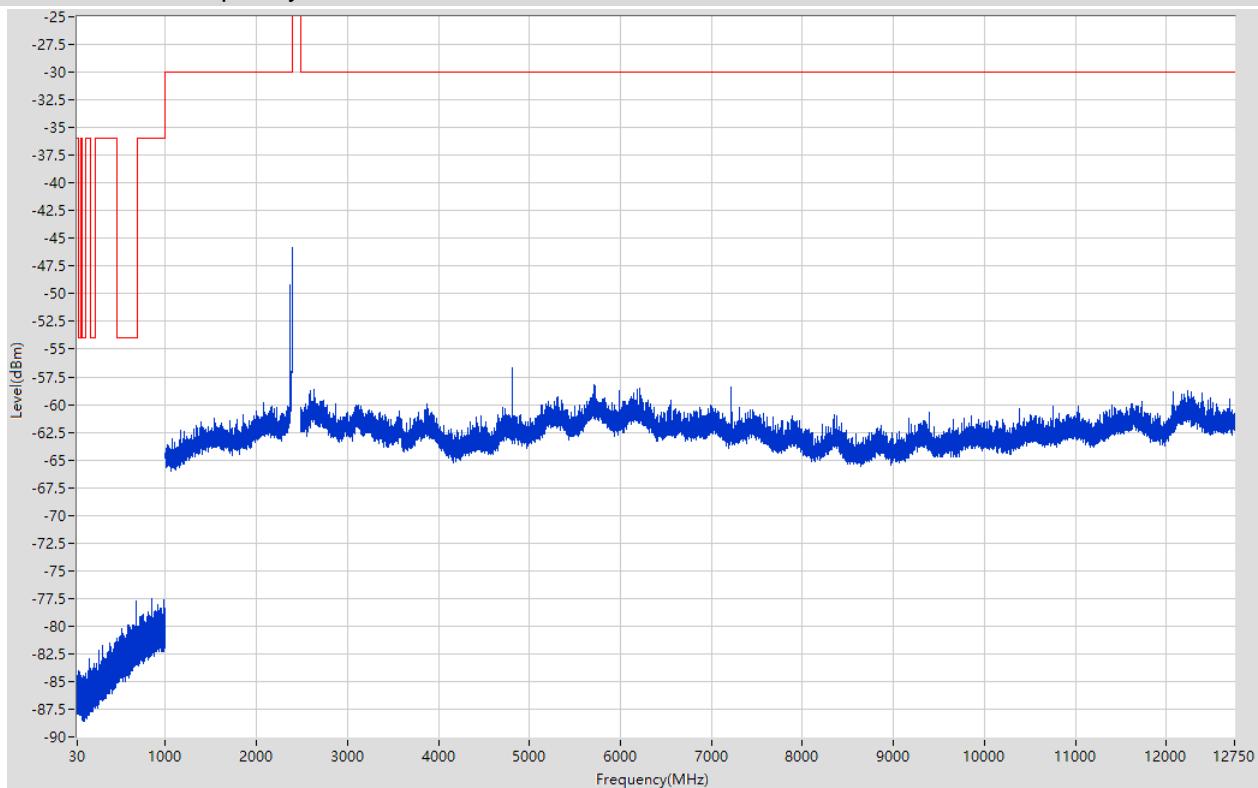
A.10 Transmitter unwanted emissions in the spurious domain

Note¹: The Frequency band was pre-scanned, the harmonic and other spurious which worst frequency are recorded in the report.

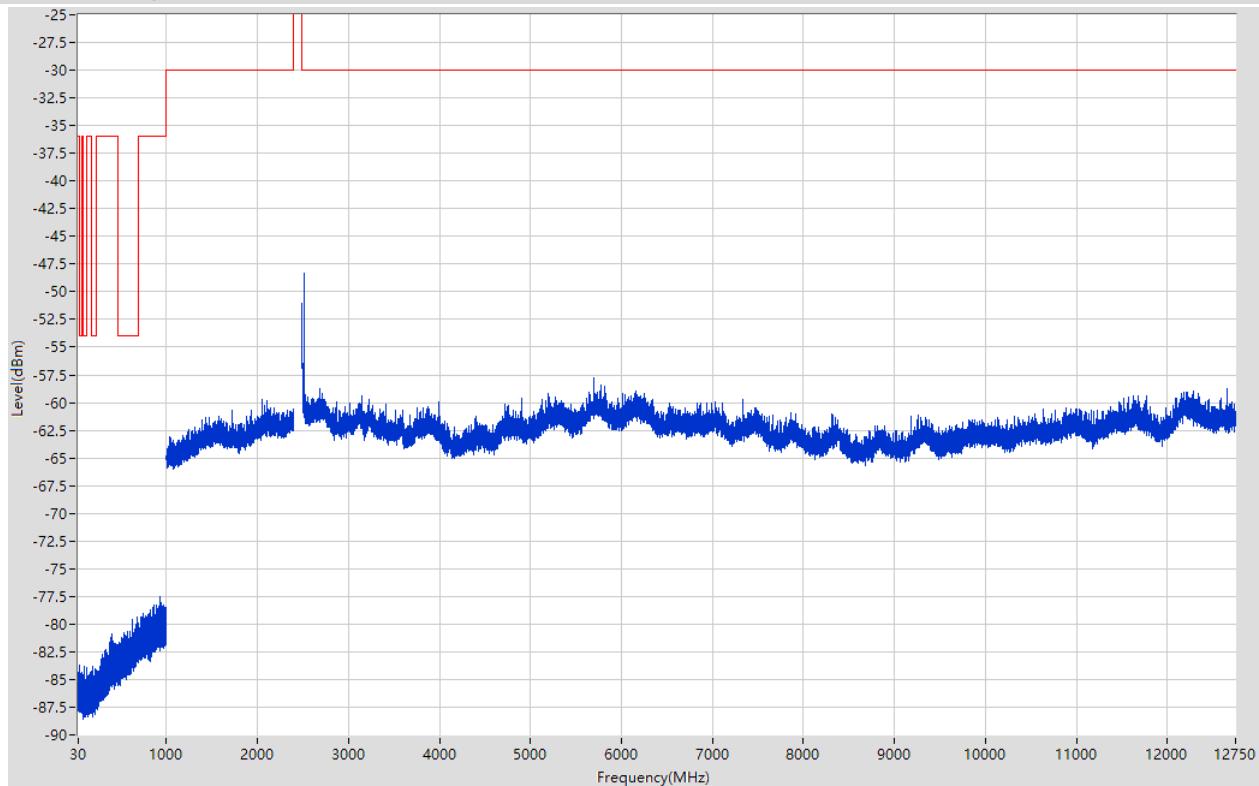
Note²: The cabinet radiated test data is tested in the normal working mode of the product.

Measuring Parameter

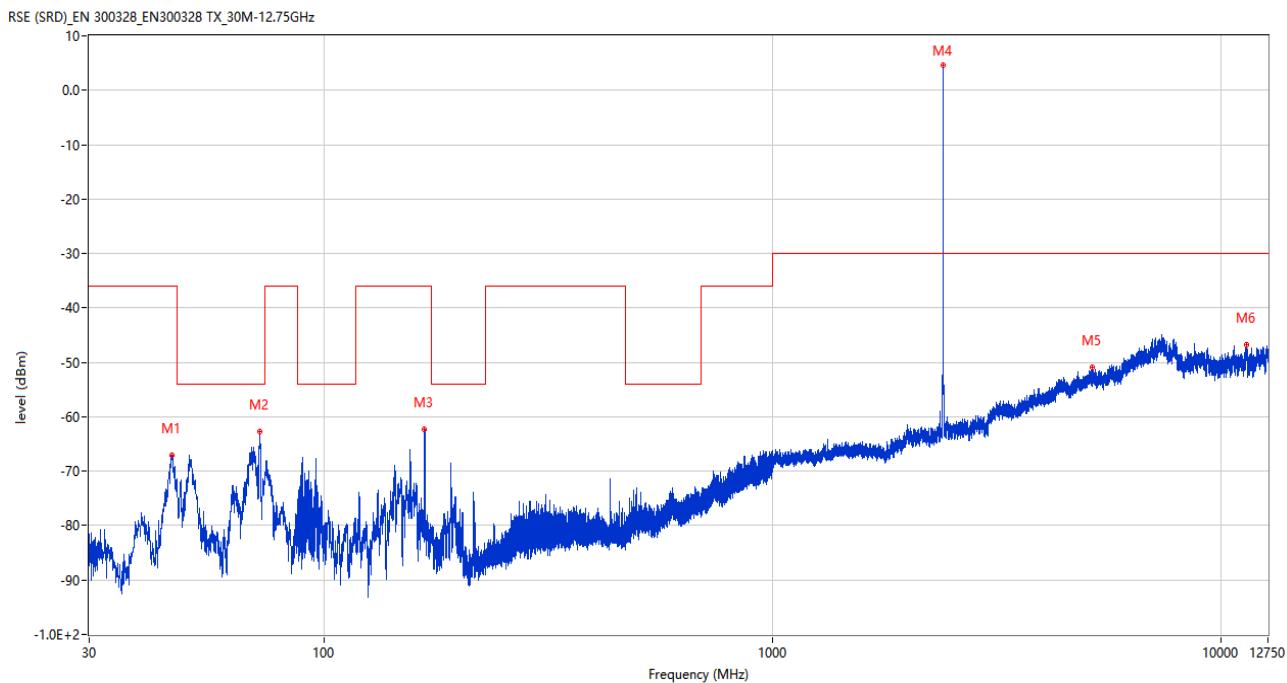
Frequency Range		
30 MHz to 1 000 MHz	RBW (MHz)	100 kHz
	VBW (MHz)	300 kHz
	Sweep points	19400
	Detector mode	Peak
	Trace mode	Max Hold
1 GHz to 12,75 GHz	RBW (MHz)	1 MHz
	VBW (MHz)	3 MHz
	Sweep points	23500
	Detector mode	Peak
	Trace mode	Max Hold

Conducted Test Data**O-QPSK: Low frequency**

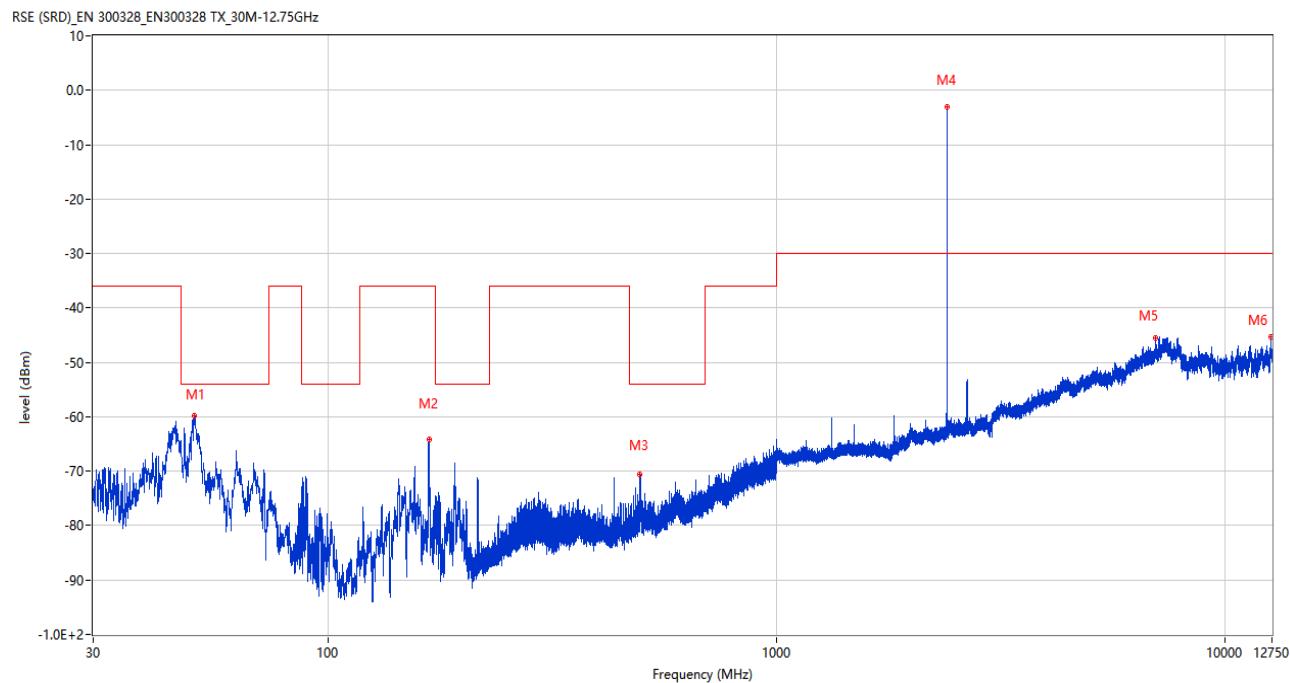
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	47	0.1	Peak	44.11	-84.03	-36	Pass	401
47	74	0.1	Peak	54.05	-84.13	-54	Pass	541
74	87.5	0.1	Peak	75.249	-84.47	-36	Pass	401
87.5	118	0.1	Peak	93.55	-84.47	-54	Pass	611
118	174	0.1	Peak	159.9	-82.98	-36	Pass	1121
174	230	0.1	Peak	208.8	-83.36	-54	Pass	1121
230	470	0.1	Peak	448.7	-81.41	-36	Pass	4801
470	694	0.1	Peak	673.05	-77.73	-54	Pass	4481
694	1000	0.1	Peak	855.45	-77.49	-36	Pass	6121
1000	2396	1	Peak	2395.501	-45.87	-30	Pass	2797
2487.5	12750	1	Peak	4811.047	-56.66	-30	Pass	20530

O-QPSK: High frequency

Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	47	0.1	Peak	46.023	-83.76	-36	Pass	401
47	74	0.1	Peak	70.55	-84.31	-54	Pass	541
74	87.5	0.1	Peak	85.576	-84.57	-36	Pass	401
87.5	118	0.1	Peak	102.05	-83.84	-54	Pass	611
118	174	0.1	Peak	126.5	-83.91	-36	Pass	1121
174	230	0.1	Peak	185.85	-83.76	-54	Pass	1121
230	470	0.1	Peak	399.2	-80.84	-36	Pass	4801
470	694	0.1	Peak	682.1	-79.35	-54	Pass	4481
694	1000	0.1	Peak	926.6	-77.55	-36	Pass	6121
1000	2396	1	Peak	2052.991	-59.7	-30	Pass	2797
2487.5	12750	1	Peak	2512.995	-48.31	-30	Pass	20530

Cabinet Radiated Test Data**30 MHz to 12.75 GHz, ANT H**

Frequency (MHz)	Result (dBm)	Factor (dB)	PK Limit (dBm)	Over Limit (dB)	Table (o)	ANT	EUT	Verdict
45.859	-67.03	-13.65	-36.0	-31.03	82.00	Horizontal	Horizontal	Pass
72.001	-62.68	-19.77	-54.0	-8.68	110.00	Horizontal	Horizontal	Pass
167.934	-62.25	-20.00	-36.0	-26.25	224.00	Horizontal	Horizontal	Pass
2405.100	4.58	-1.36	-30.0	34.58	61.00	Horizontal	Horizontal	N/A
5174.500	-50.98	10.96	-30.0	-20.98	113.00	Horizontal	Horizontal	Pass
11417.388	-46.68	15.67	-30.0	-16.68	80.00	Horizontal	Horizontal	Pass

30 MHz to 12.75 GHz, ANT V

Frequency (MHz)	Result (dBm)	Factor (dB)	PK Limit (dBm)	Over Limit (dB)	Table (o)	ANT	EUT	Verdict
50.322	-59.84	-17.01	-54.0	-5.84	340.00	Vertical	Horizontal	Pass
168.516	-64.10	-19.88	-36.0	-28.10	99.00	Vertical	Horizontal	Pass
497.491	-70.65	-7.98	-54.0	-16.65	249.00	Vertical	Horizontal	Pass
2405.300	-3.08	-1.35	-30.0	26.92	273.00	Vertical	Horizontal	N/A
7029.750	-45.57	14.98	-30.0	-15.57	138.00	Vertical	Horizontal	Pass
12680.887	-45.27	17.45	-30.0	-15.27	300.00	Vertical	Horizontal	Pass

A.11 Receiver Spurious Emissions

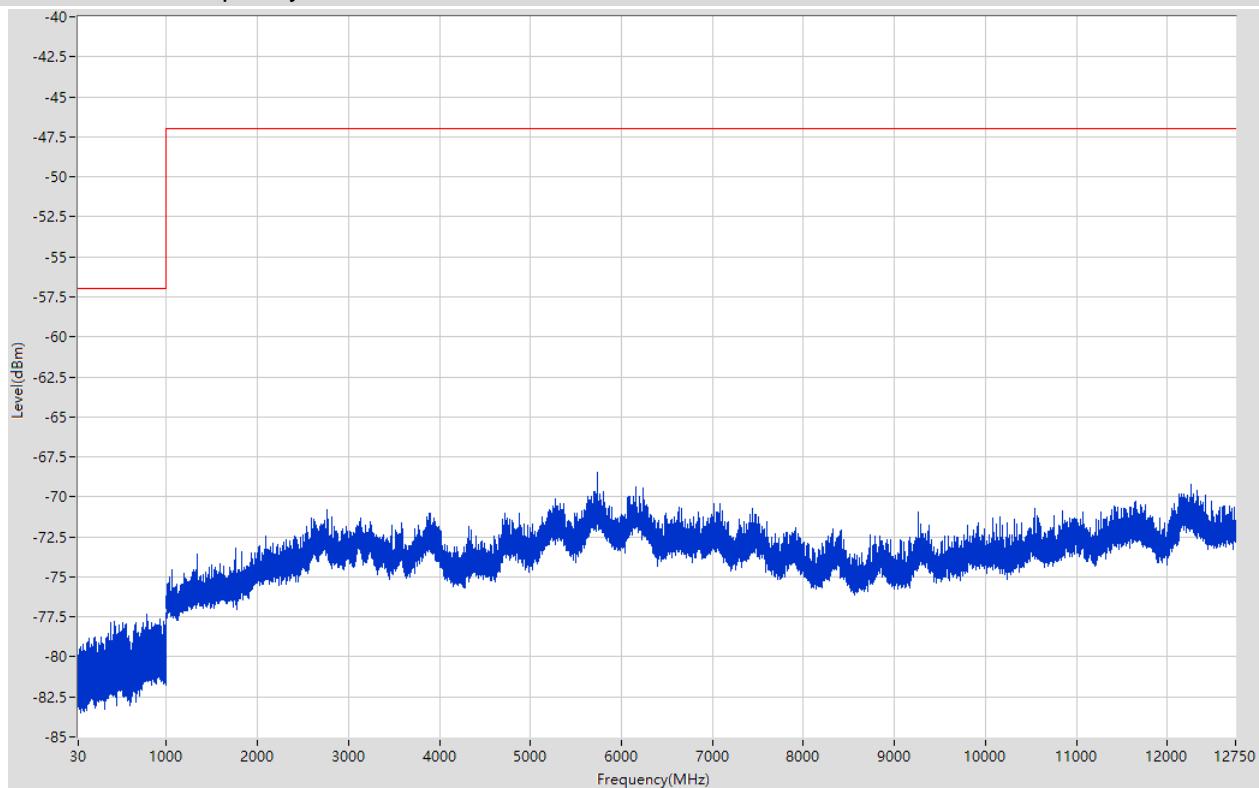
Note¹: The test method choose the conducted method. Which power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment (cabinet radiation).

Note²: The Frequency band was pre-scanned, the harmonic and other spurious which worst frequency are recorded in the report.

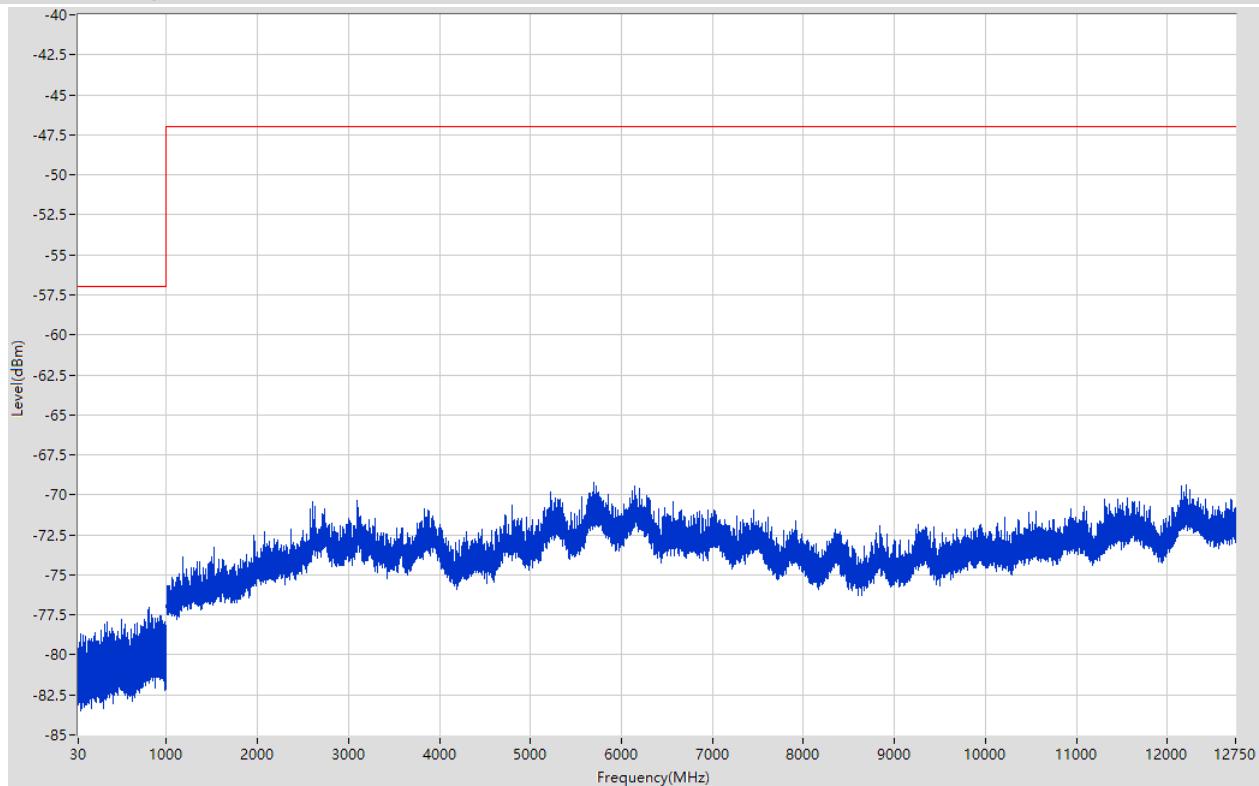
Note³: The cabinet radiated test data is tested in the normal working mode of the product.

Measuring Parameter

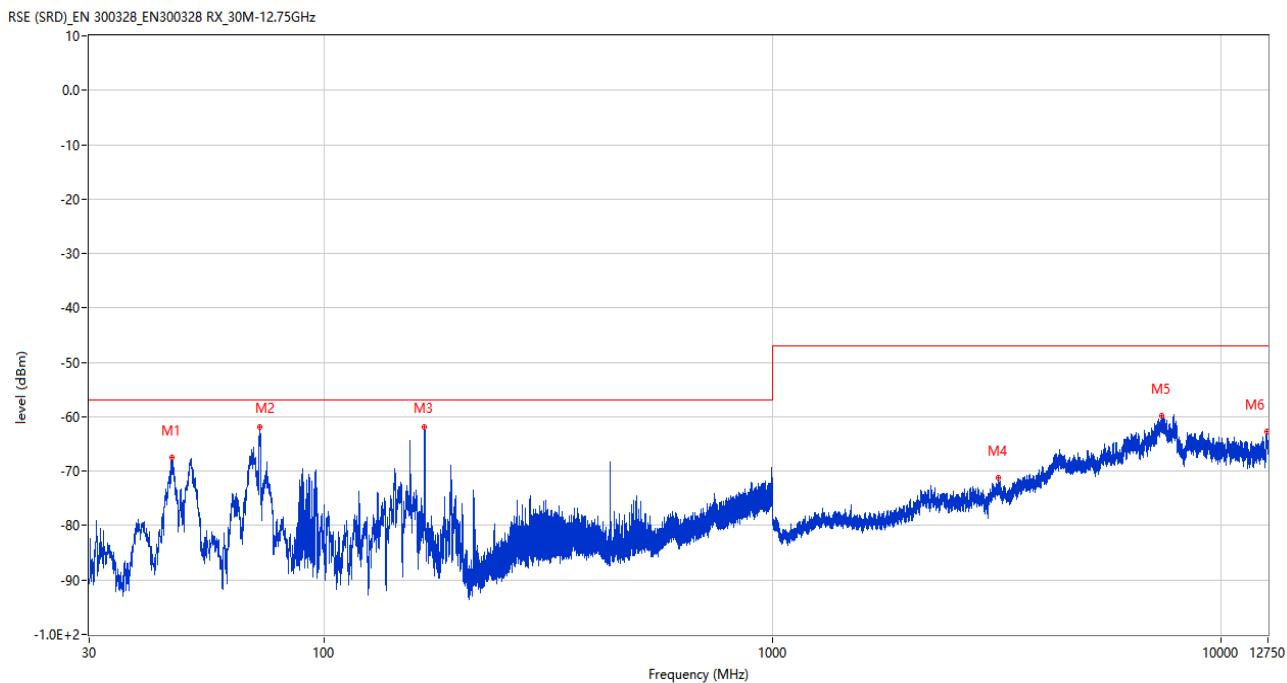
Frequency Range		
30 MHz to 1 000 MHz	RBW (MHz)	100 kHz
	VBW (MHz)	300 kHz
	Sweep points	19400
	Detector mode	Peak
	Trace mode	Max Hold
1 GHz to 12,75 GHz	RBW (MHz)	1 MHz
	VBW (MHz)	3 MHz
	Sweep points	23500
	Detector mode	Peak
	Trace mode	Max Hold

Conducted Test Data**O-QPSK: Low frequency**

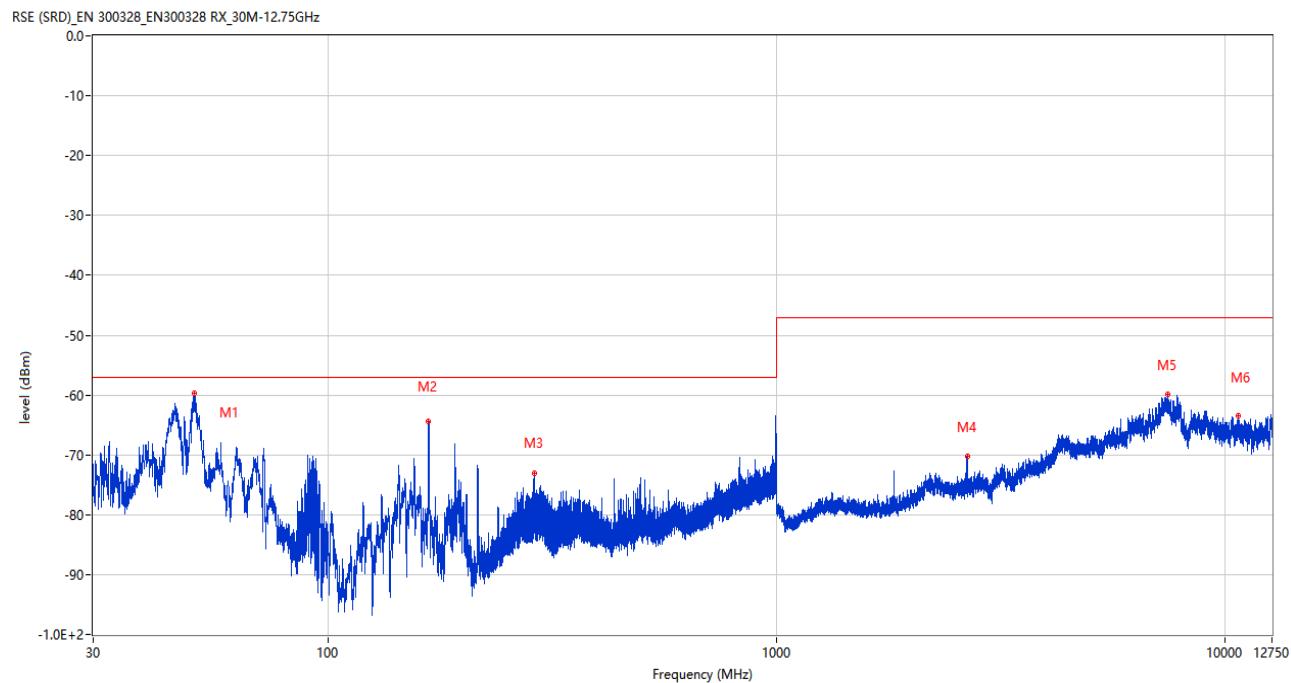
Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	1000	0.1	Peak	991.45	-77.3	-57	Pass	19401
1000	12750	1	Peak	5732.5	-68.5	-47	Pass	23501

O-QPSK: High frequency

Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	1000	0.1	Peak	804.55	-77.02	-57	Pass	19401
1000	12750	1	Peak	5693	-69.2	-47	Pass	23501

Cabinet Radiated Test Data**30 MHz to 12.75 GHz, ANT H**

Frequency (MHz)	Result (dBm)	Factor (dB)	PK Limit (dBm)	Over Limit (dB)	Table (o)	ANT	EUT	Verdict
45.956	-67.43	-13.23	-57.0	-10.43	90.00	Horizontal	Horizontal	Pass
71.904	-61.98	-19.76	-57.0	-4.98	94.00	Horizontal	Horizontal	Pass
167.788	-61.93	-20.03	-57.0	-4.93	223.00	Horizontal	Horizontal	Pass
3193.500	-71.12	-9.82	-47.0	-24.12	235.00	Horizontal	Horizontal	Pass
7383.000	-59.82	0.91	-47.0	-12.82	235.00	Horizontal	Horizontal	Pass
12680.651	-62.74	1.07	-47.0	-15.74	299.00	Horizontal	Horizontal	Pass

30 MHz to 12.75 GHz, ANT V

Frequency (MHz)	Result (dBm)	Factor (dB)	PK Limit (dBm)	Over Limit (dB)	Table (o)	ANT	EUT	Verdict
50.322	-60.22	-17.01	-57.0	-3.22	360.00	Vertical	Horizontal	Pass
167.740	-64.41	-20.04	-57.0	-7.41	95.00	Vertical	Horizontal	Pass
288.408	-73.14	-14.12	-57.0	-16.14	281.00	Vertical	Horizontal	Pass
2666.200	-70.20	-13.19	-47.0	-23.20	107.00	Vertical	Horizontal	Pass
7467.250	-59.89	3.19	-47.0	-12.89	184.00	Vertical	Horizontal	Pass
10716.287	-63.49	-1.80	-47.0	-16.49	133.00	Vertical	Horizontal	Pass

A.12 Receiver Blocking

For 2.4G ISM Band

Note1: The combination of the smallest channel bandwidth and the lowest data rate was reported.

Note2: Blocking signal levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels corrected by the actual antenna assembly gain.

Test Data

Receiver Category 2 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal Frequency (MHz)	Blocking signal power (dBm)	PER Result		Limit	Verdict
			Low channel	High channel		
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}) + 10 \text{ dB}) \text{ or } (-74 \text{ dBm} + 10 \text{ dB})$ whichever is less	2 380	-34	0.00%	0.00%	$\leq 10\%$	Pass
	2 504	-34	0.00%	0.00%		
	2 300	-34	0.00%	0.00%		
	2 584	-34	0.00%	0.00%		

Test Plot (PER)

Note: All the configuration were tested, but only the worst PER Plot were reported in this report.

For 2.4G ISM Band

Low Channel

```
[2022-06-09_15:52:06]{{(status)}}{UserTxCount:0}{AckTxCount:0}{UserTxAborted:0}
{AckTxAborted:0}{UserTxBlocked:0}{AckTxBlocked:0}{UserTxUnderflow:0}
{AckTxUnderflow:0}{RxCount:0}{SyncDetect:1500}{NoRxBuffer:0}{RfSensed:0}
{ackTimeout:0}{ackTxFpSet:0}{ackTxFpFail:0}{ackTxFpAddrFail:0}{RfState:Idle}
{RAIL_state_active:1}{RAIL_state_rx:0}{RAIL_state_tx:0}{Channel:11}{AppMode:None}
{TimingLost:0}{TimingDetect:0}{FrameErrors:1500}{RxOverflow:0}{AddrFilt:0}
{Aborted:0}{Calibrations:2}{TxChannelBusy:0}{TxClear:0}{TxCca:0}{TxRetry:0}}
```

High Channel

```
[2022-06-09_16:00:19]{{(status)}}{UserTxCount:0}{AckTxCount:0}{UserTxAborted:0}
{AckTxAborted:0}{UserTxBlocked:0}{AckTxBlocked:0}{UserTxUnderflow:0}
{AckTxUnderflow:0}{RxCount:0}{SyncDetect:1500}{NoRxBuffer:0}{RfSensed:0}
{ackTimeout:0}{ackTxFpSet:0}{ackTxFpFail:0}{ackTxFpAddrFail:0}{RfState:Idle}
{RAIL_state_active:1}{RAIL_state_rx:0}{RAIL_state_tx:0}{Channel:25}{AppMode:None}
{TimingLost:0}{TimingDetect:0}{FrameErrors:1500}{RxOverflow:0}{AddrFilt:0}
{Aborted:0}{Calibrations:2}{TxChannelBusy:0}{TxClear:0}{TxCca:0}{TxRetry:0}}
[2022-06-09_16:00:19]
```

ANNEX B TEST SETUP PHOTOS

Please refer the document "BL-SZ2240344-AR.pdf".

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document "BL-SZ2240344-AW.pdf".

ANNEX D EUT INTERNAL PHOTOS

Please refer the document "BL-SZ2240344-AI.pdf".

Statement

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--END OF REPORT--